Mix Design

OBJECTIVES OF MIX DESIGN

- EVALUATE MATERIALS
- DETERMINE AGGREGATE PROPORTIONS
- DETERMINE OPTIMUM ASPHALT CONTENT
- EVALUATE DESIGN MIX

AGGREGATE EVALUATION

- GRADATION
- L A ABRASION
- FRACTURED FACES
- NATURAL SAND
- FLAT AND ELONGATED

Aggregate Sample Splitter

Types of Sampling

- Representative
- Random

Gradation / Sieve Analysis

- ASTM D5444

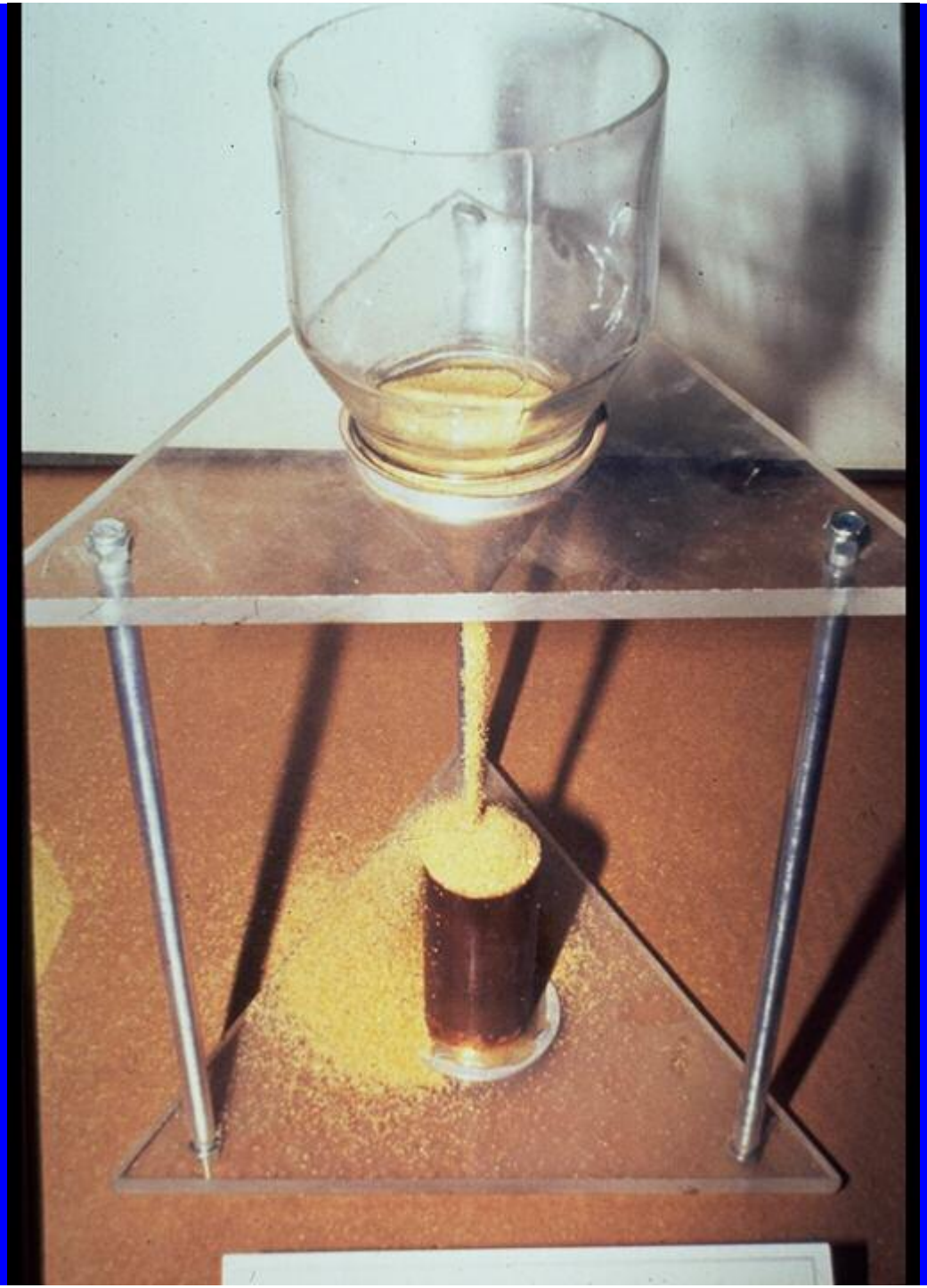

EXIT 90

Los Angeles Abrasion

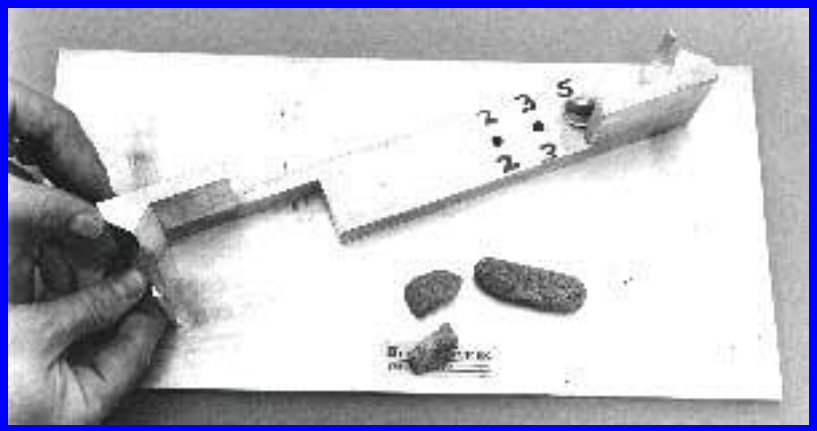
- ASTM C535 & ASTM C131
- Aggregate is placed in a steel drum with 12 steel balls for the required number of revolutions.
- Percent loss is then calculated as the LA abrasion.

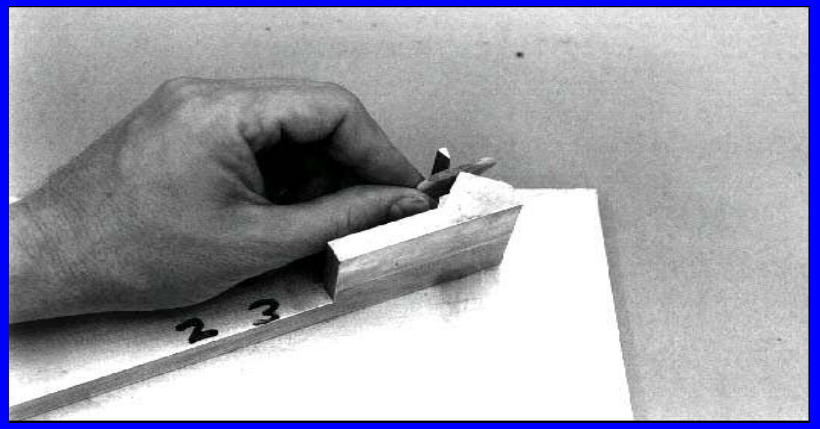
Fractured Faces

- **ASTM D5821**



Flat & Elongated





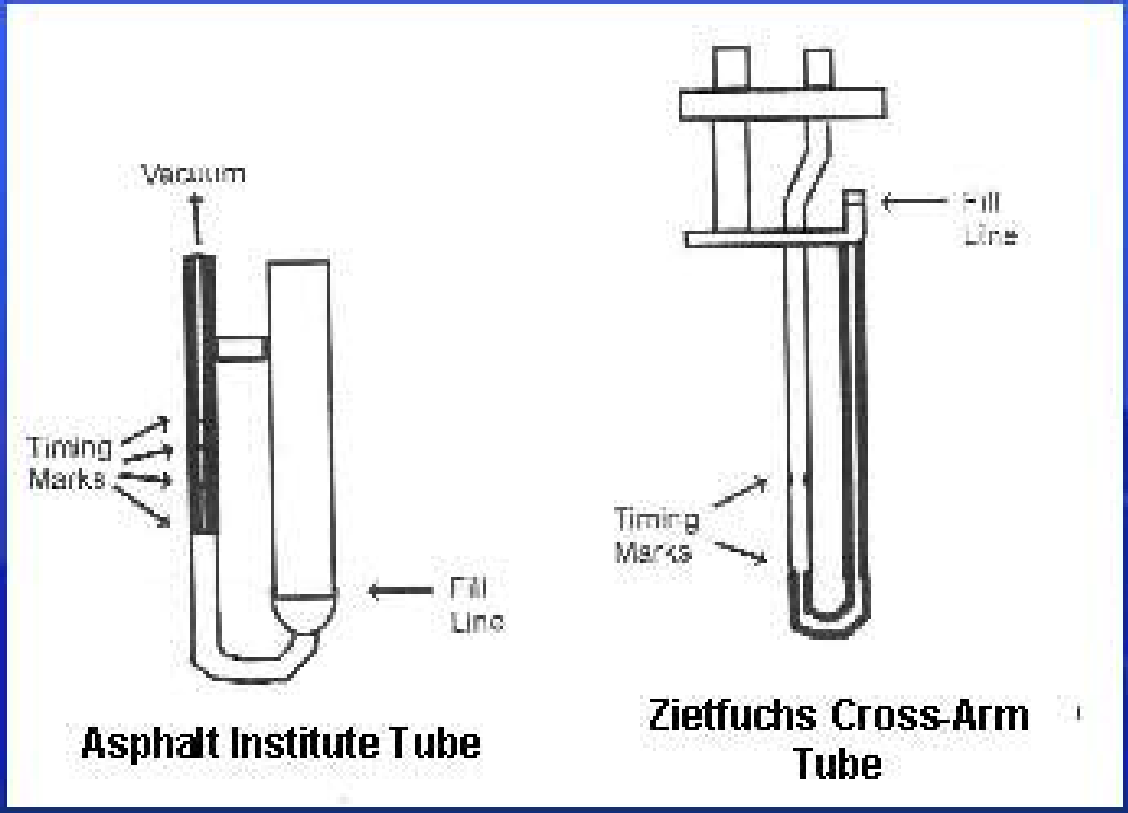
BINDER PROPERTIES

- VISCOSITY GRADED
- PG GRADED

VISCOSITY GRADED

- VISCOSITY
- VISCOSITY AFTER TFOT
- DUCTILITY

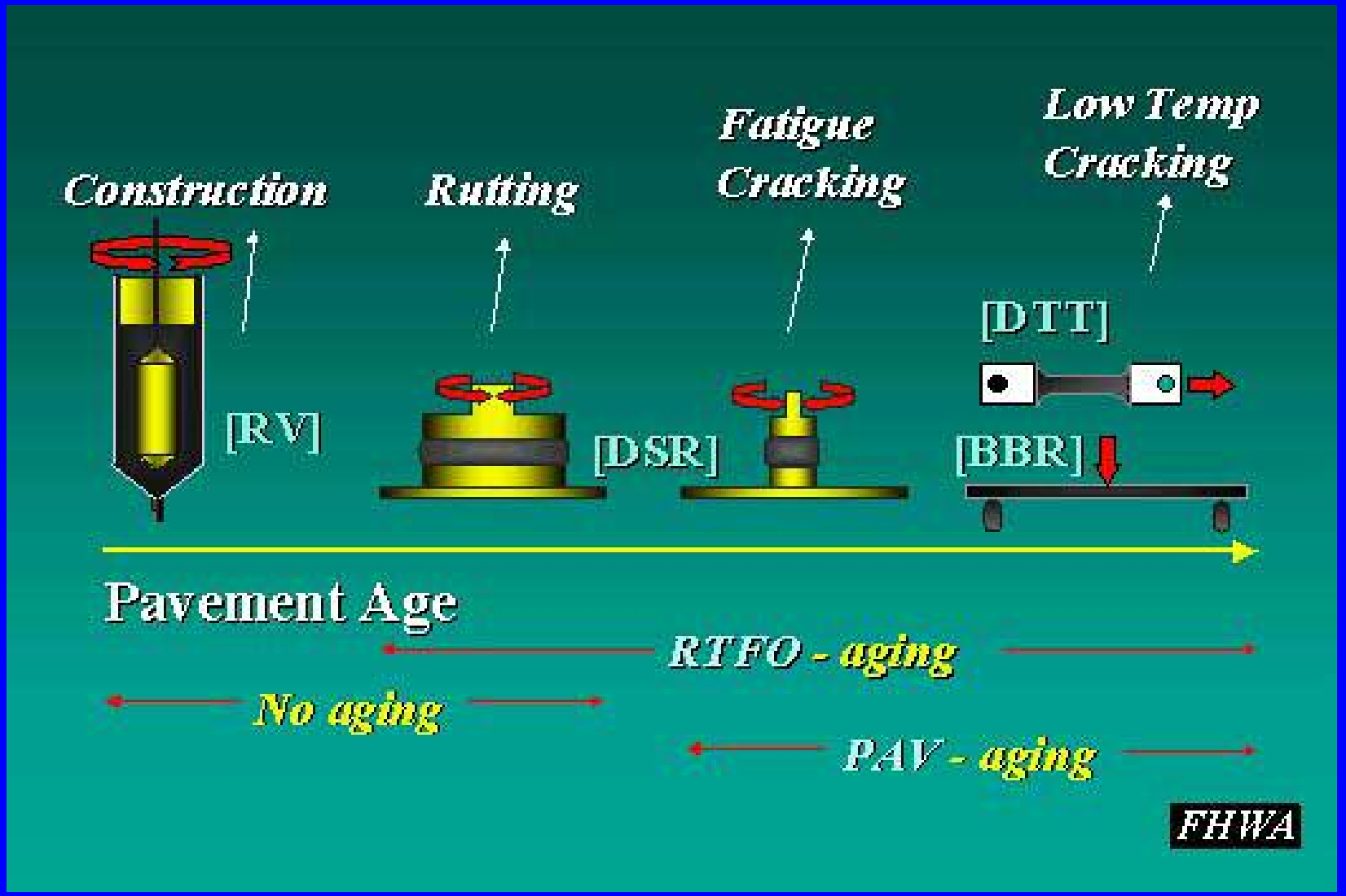
Types of Viscosity Tubes



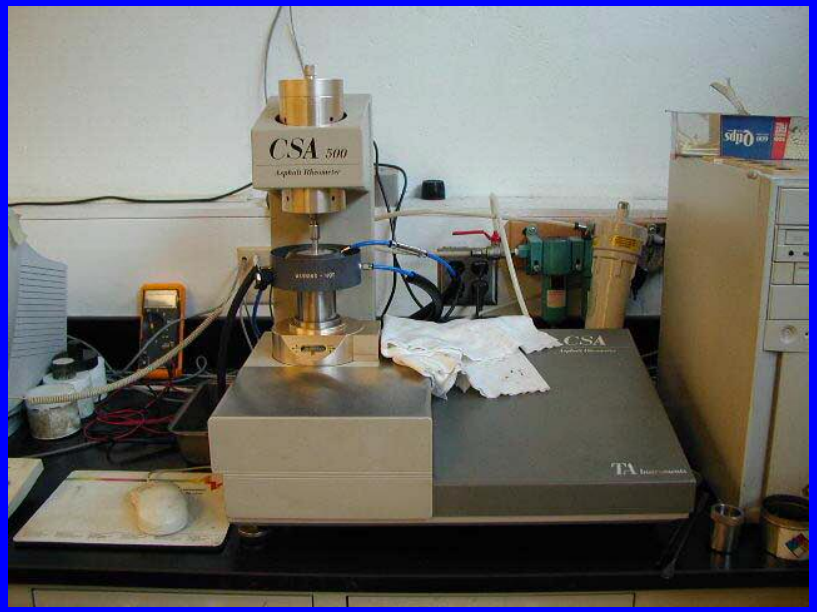
Courtesy of NCAT

PG GRADED

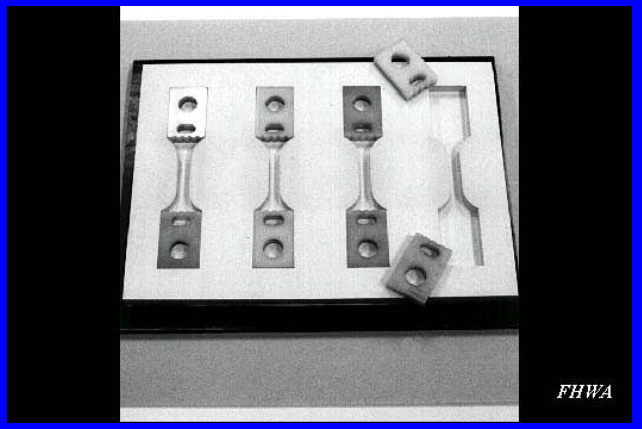
- DYNAMIC SHEAR RHEOMETER
- BENDING BEAM RHEOMETER
- ROTATIONAL VISCOMETER

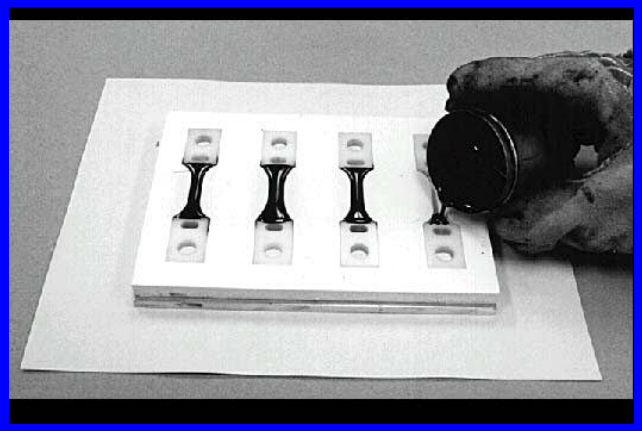

Construction
Rutting
Fatigue Cracking
Low Temp Cracking
[RV]
[DSR]
[DTT]
[BBR]
Pavement Age
RTFO - aging
No aging
PAV - aging
FHWA

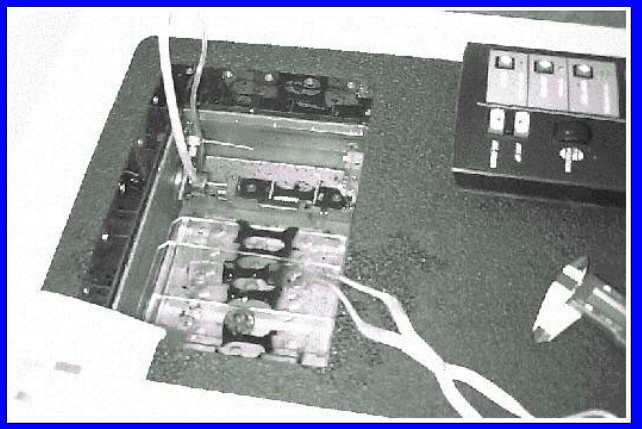
Dynamic Shear Rheometer



Direct Tension Tester







Bending Beam Rheometer

BINDER TESTS NOT NORMALLY CONDUCTED IN FIELD LAB

IF AGGREGATE PROPERTIES AND ASPHALT PROPERTIES ARE OK THEN DETERMINE OPTIMUM ASPHALT CONTENT

TWO METHODS GENERALLY USED TO DETERMINE OPTIMUM ASPHALT CONTENT

- MARSHALL
- SUPERPAVE

MARSHALL METHOD

- DEVELOPED BY CORPS OF ENGINEERS
- SIMPLE, QUICK, INEXPENSIVE

What is Superpave?

Superpave is a Mix Design Procedure and a Binder Classification System

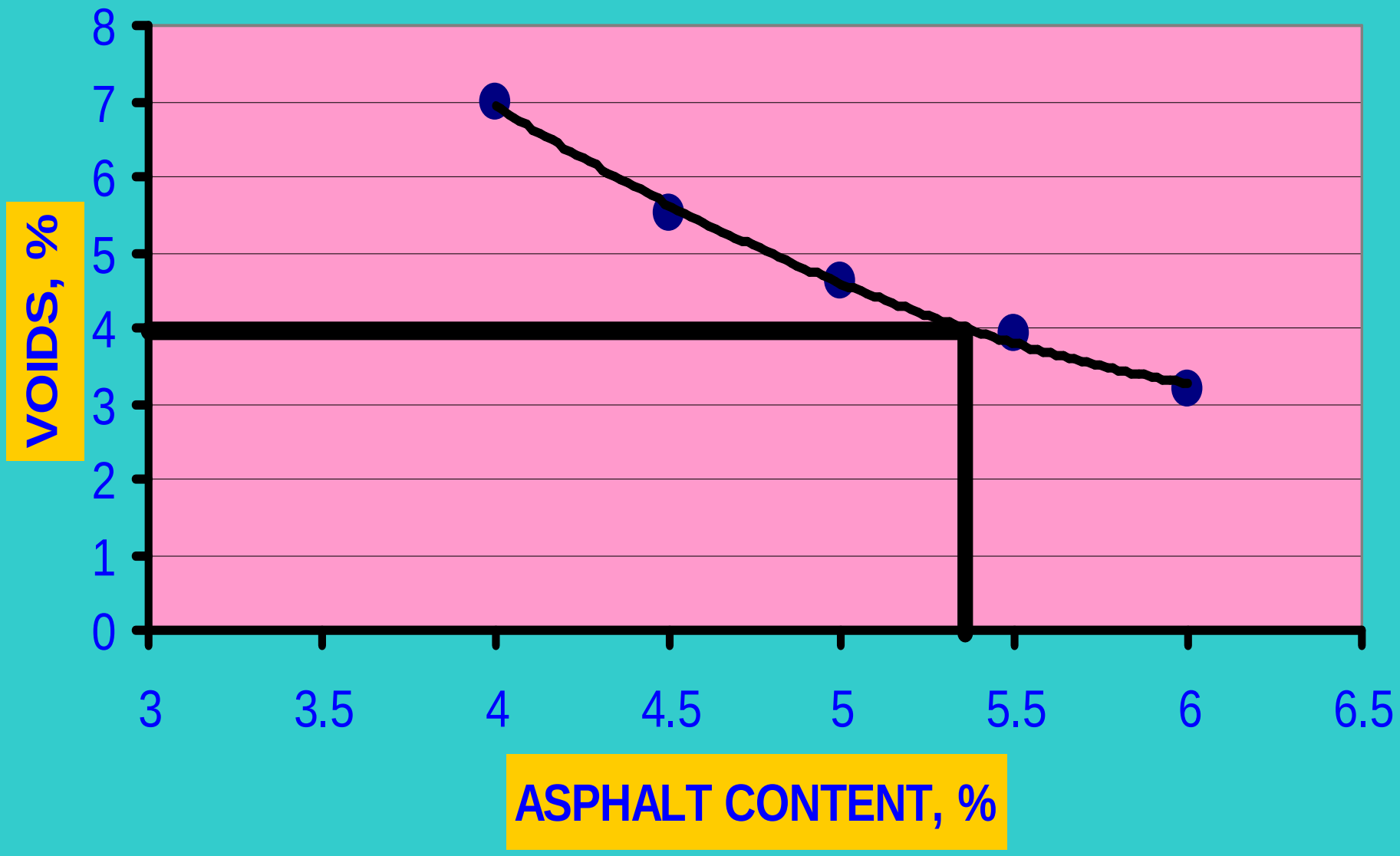
SUPERPAVE METHOD

- DEVELOPED IN 1990's
- NOT YET ADOPTED FOR AIRFIELDS
- INVOLVES USING NEWLY DEVELOPED GYRATORY COMPACTOR


CAUTION

USES 6-INCH DIAMETER SAMPLES

VOIDS VS. ASPHALT CONTENT



MARSHALL METHOD

- DEVELOPED BY CORPS OF ENGINEERS
- SIMPLE, QUICK, INEXPENSIVE

USES 4-INCH DIAMETER SAMPLES

BLEND 15 TO 20 AGGREGATE SAMPLES AT SELECTED PROPORTIONS

VARY ASPHALT CONTENT IN 0.5 % INCREMENTS


1/13/95
HOBART
HOBART

COMPACT SAMPLES USING SPECIFIED EFFORT

THREE TYPES OF HAMMER

- MANUAL
- MECHANICAL
- MECHANICAL WITH SLANTED FOOT AND ROTATING BASE

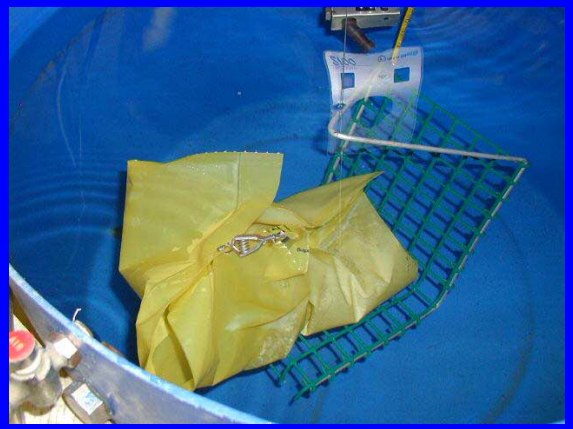
Pedestal and Hammer Requirements

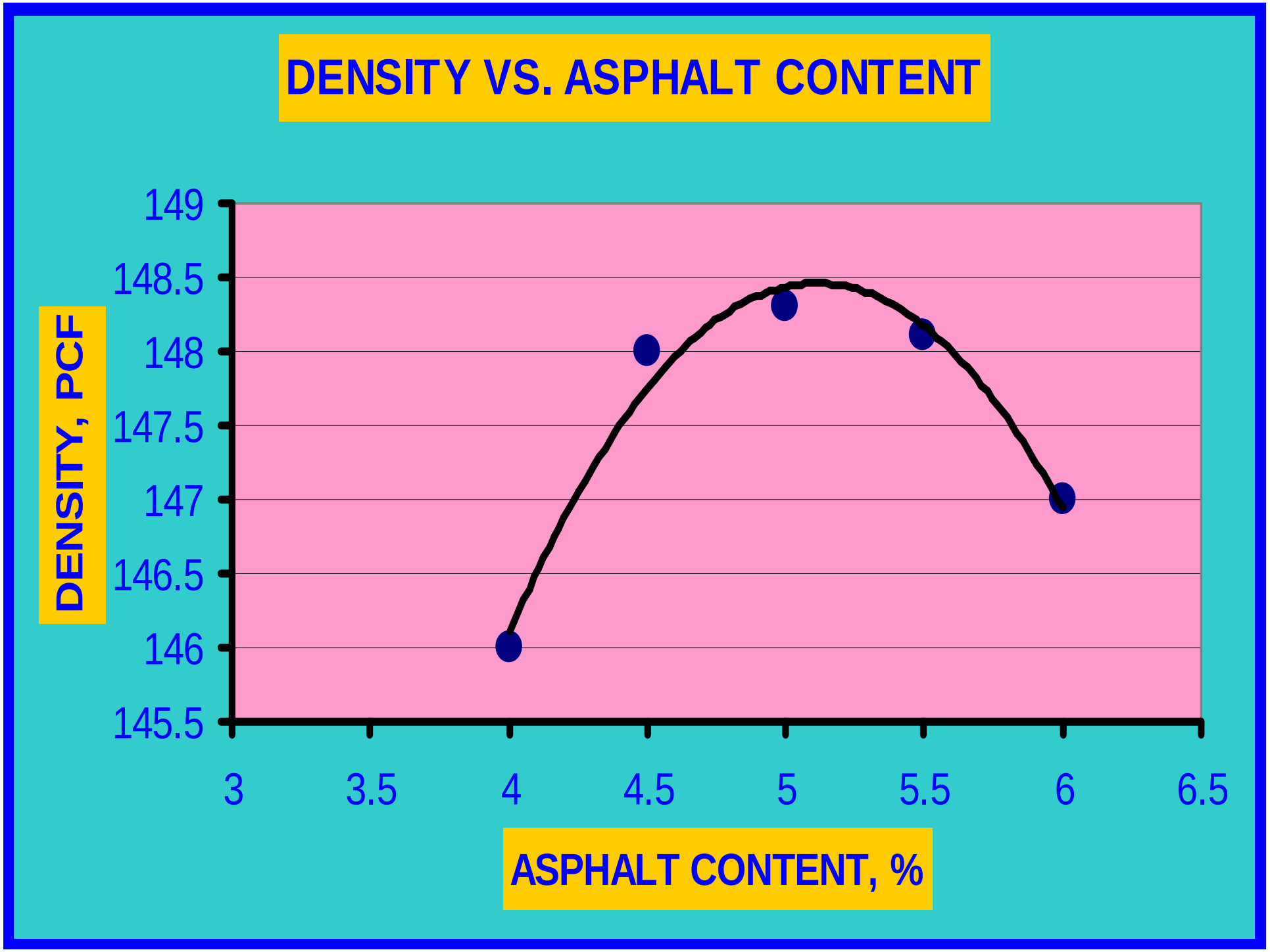
- Pedestal should be on solid base
- Use manual hammer
- Make sure hammer is proper weight and no significant friction
- Make sure pedestal is not cracked

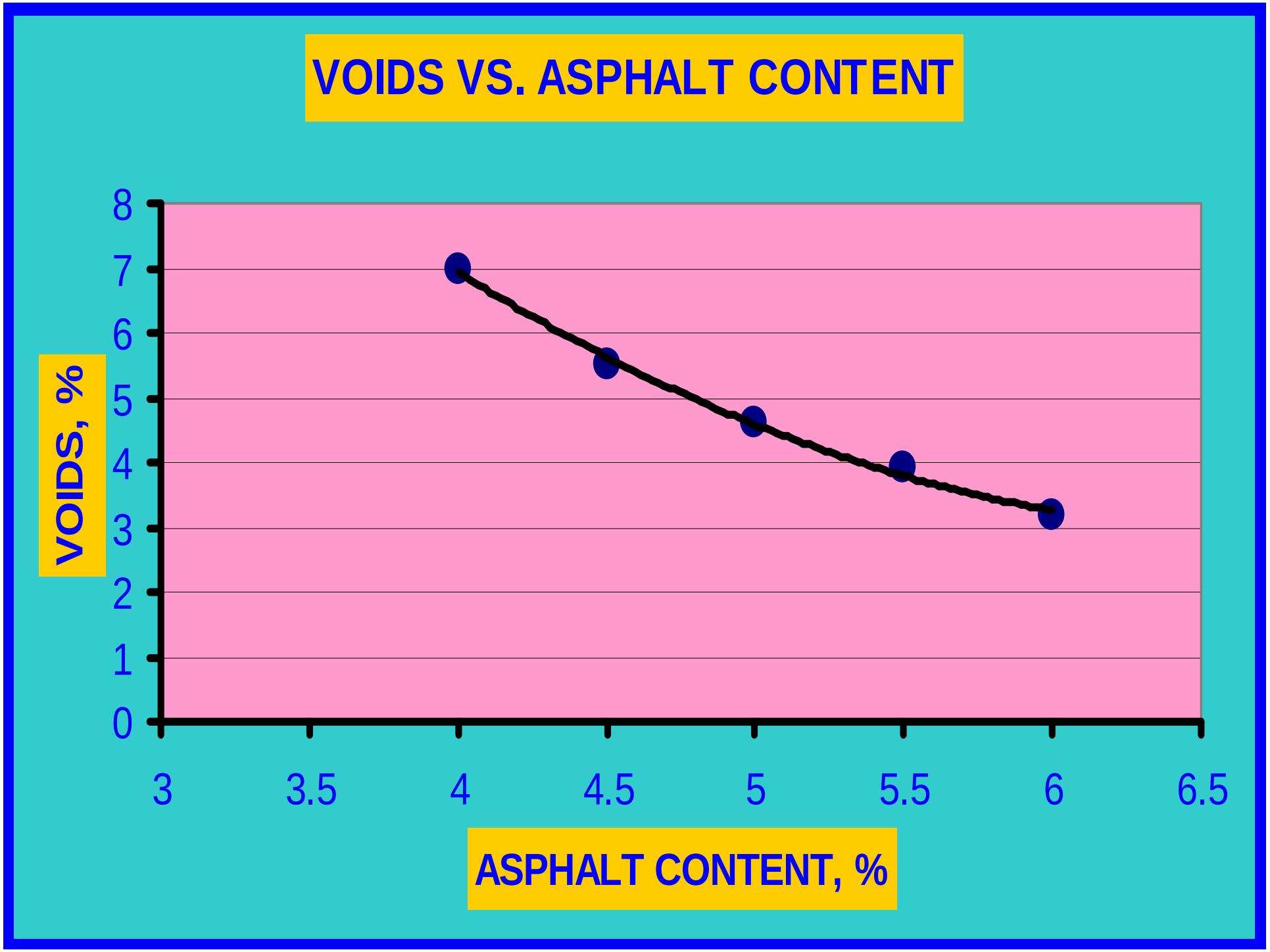

HART

Bulk Specific Gravity

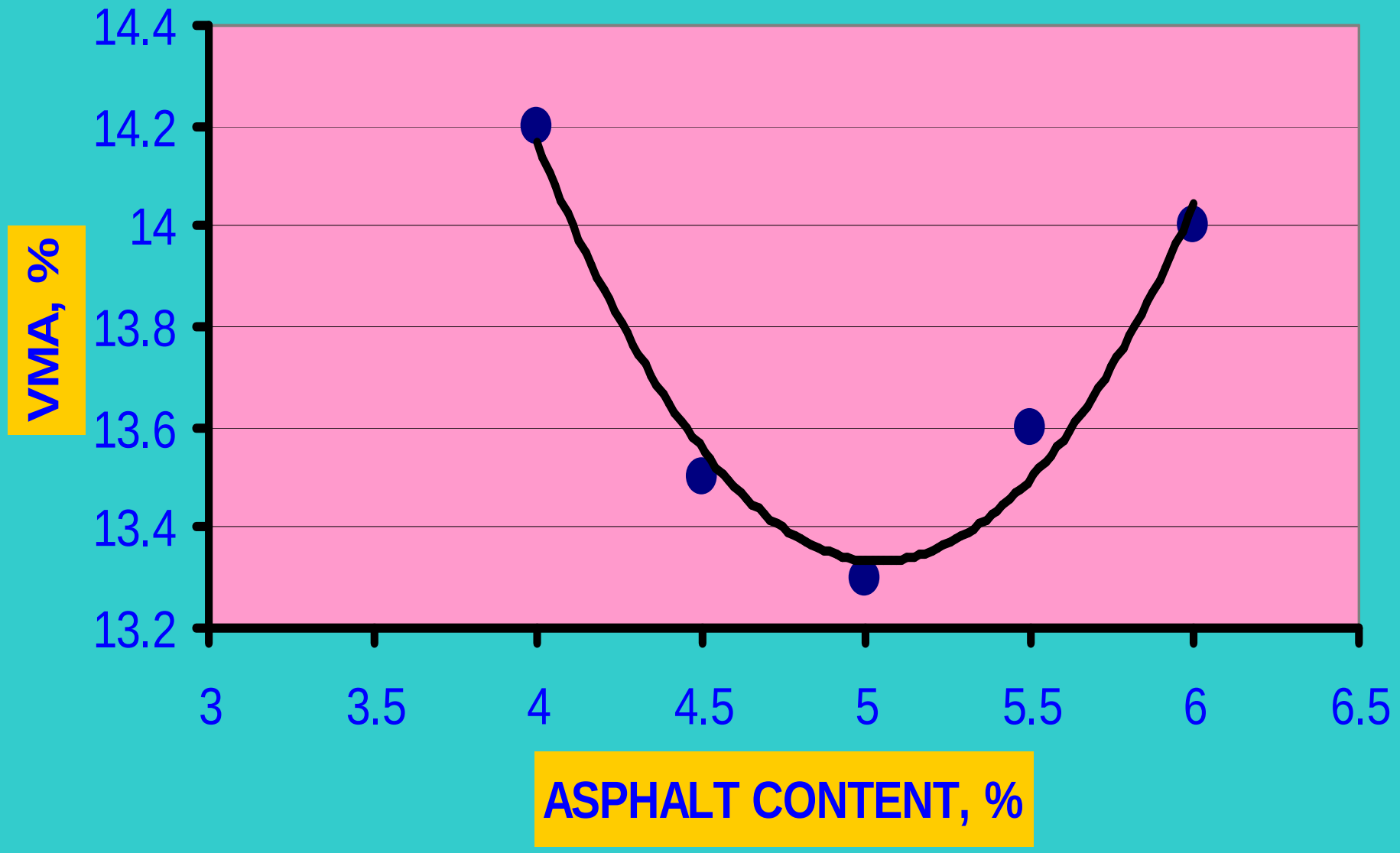
CoreLok Specific Gravity

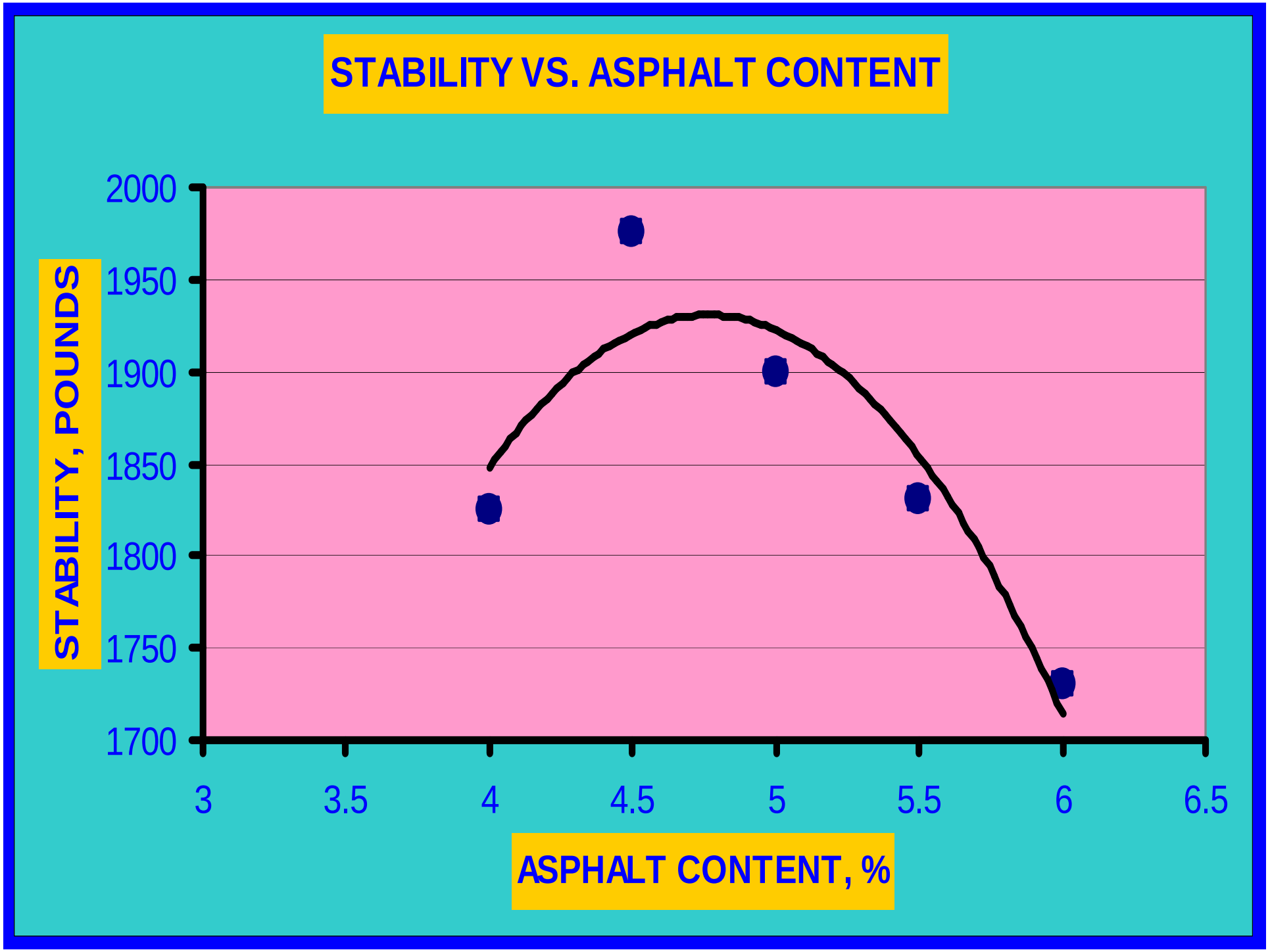



DENSITY VS. ASPHALT CONTENT
DENSITY, PCF
149
148.5
148
147.5
147
146.5
146
145.5
3
3.5
4
4.5
5
5.5
6
6.5
ASPHALT CONTENT, %

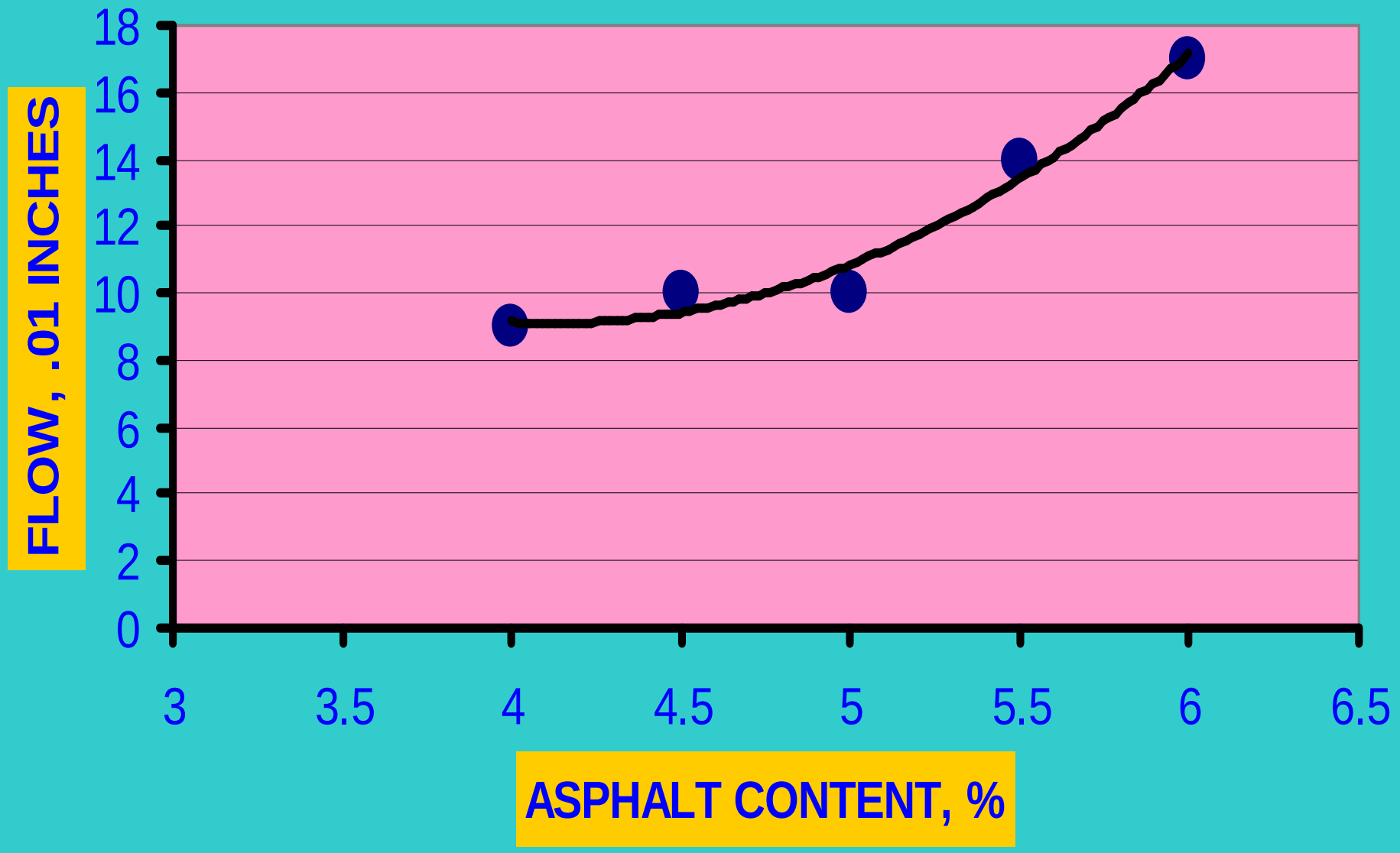

VOIDS VS. ASPHALT CONTENT
VOIDS, %
8
7
6
5
4
3
2
1
0
3
3.5
4
4.5
5
5.5
6
6.5
ASPHALT CONTENT, %

VMA VS. ASPHALT CONTENT



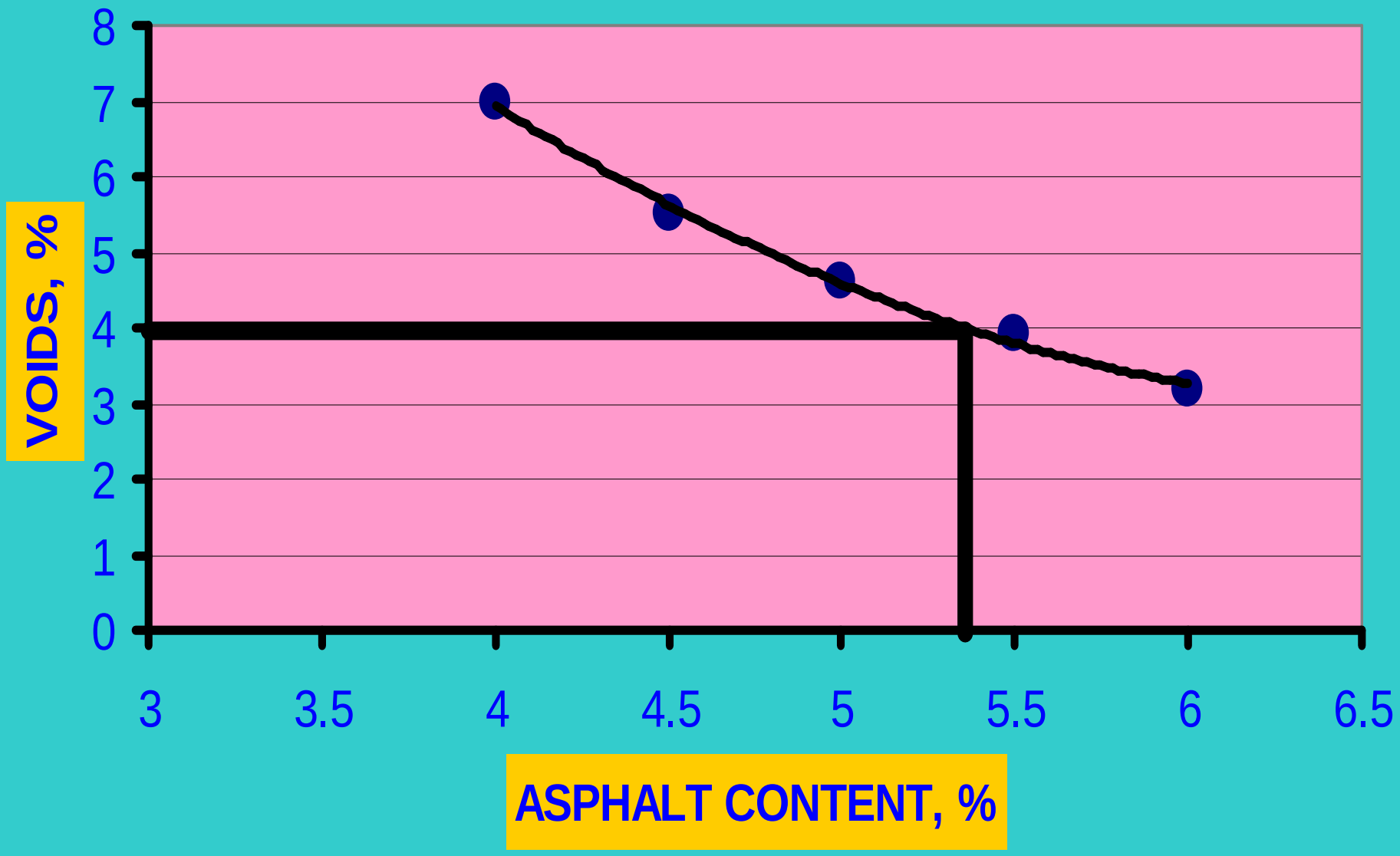

STABILITY VS. ASPHALT CONTENT
STABILITY, POUNDS
2000
1950
1900
1850
1800
1750
1700
3
3.5
4
4.5
5
5.5
6
6.5
ASPHALT CONTENT, %

FLOW VS. ASPHALT CONTENT



TYPICALLY SELECT OPTIMUM ASPHALT CONTENT AT 4 PERCENT AIR VOIDS

VOIDS VS. ASPHALT CONTENT



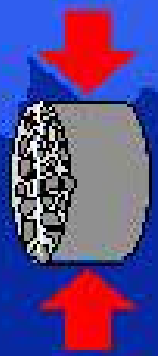
AFTER SELECTING OPTIMUM ASPHALT CONTENT CHECK FOR STABILITY AND MOISTURE SUSCEPTIBILITY

Marshall Stability

Moisture Sensitivity

AASHTO T 283

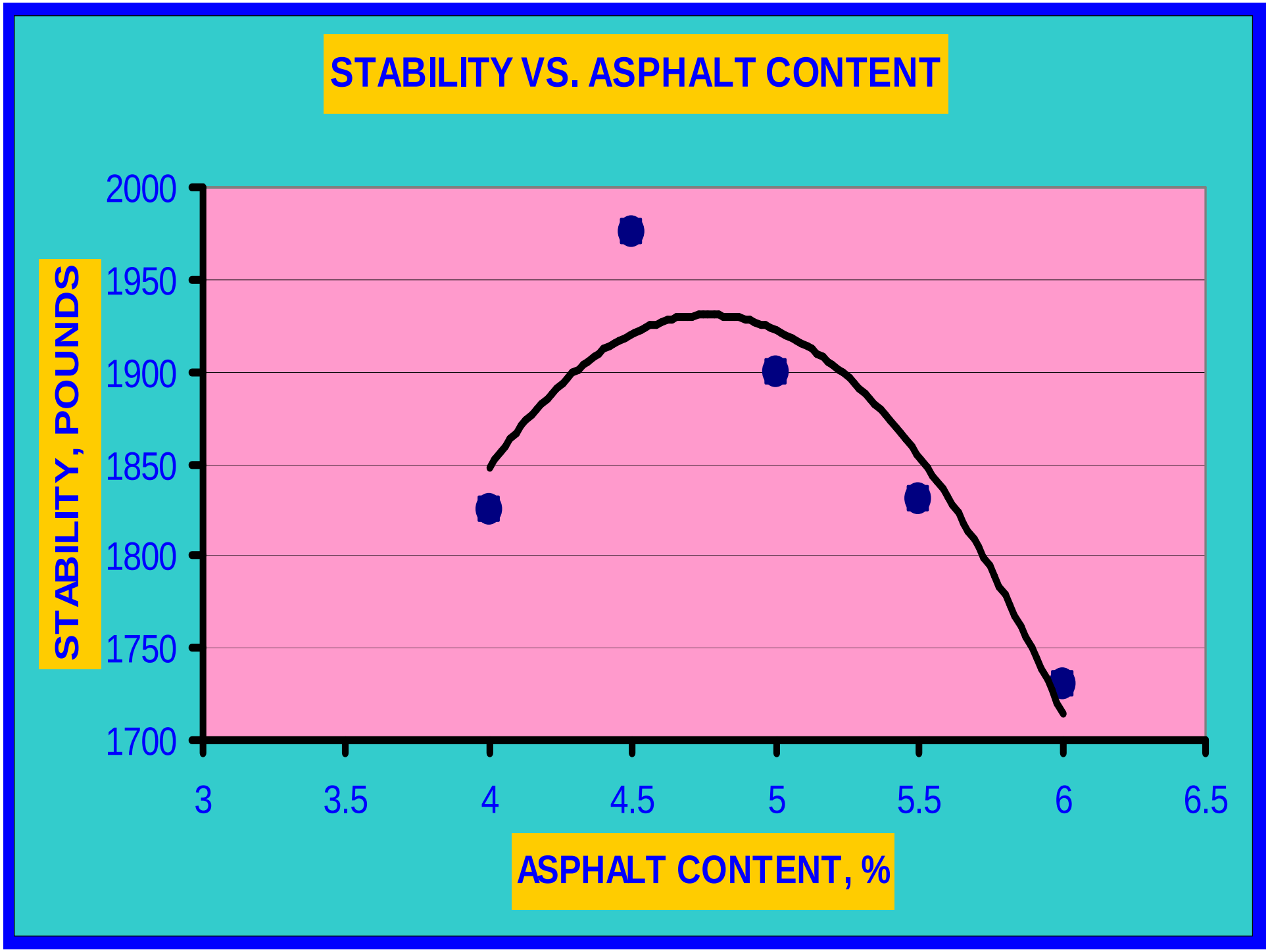
Determine the tensile strengths of both sets of 3 specimens



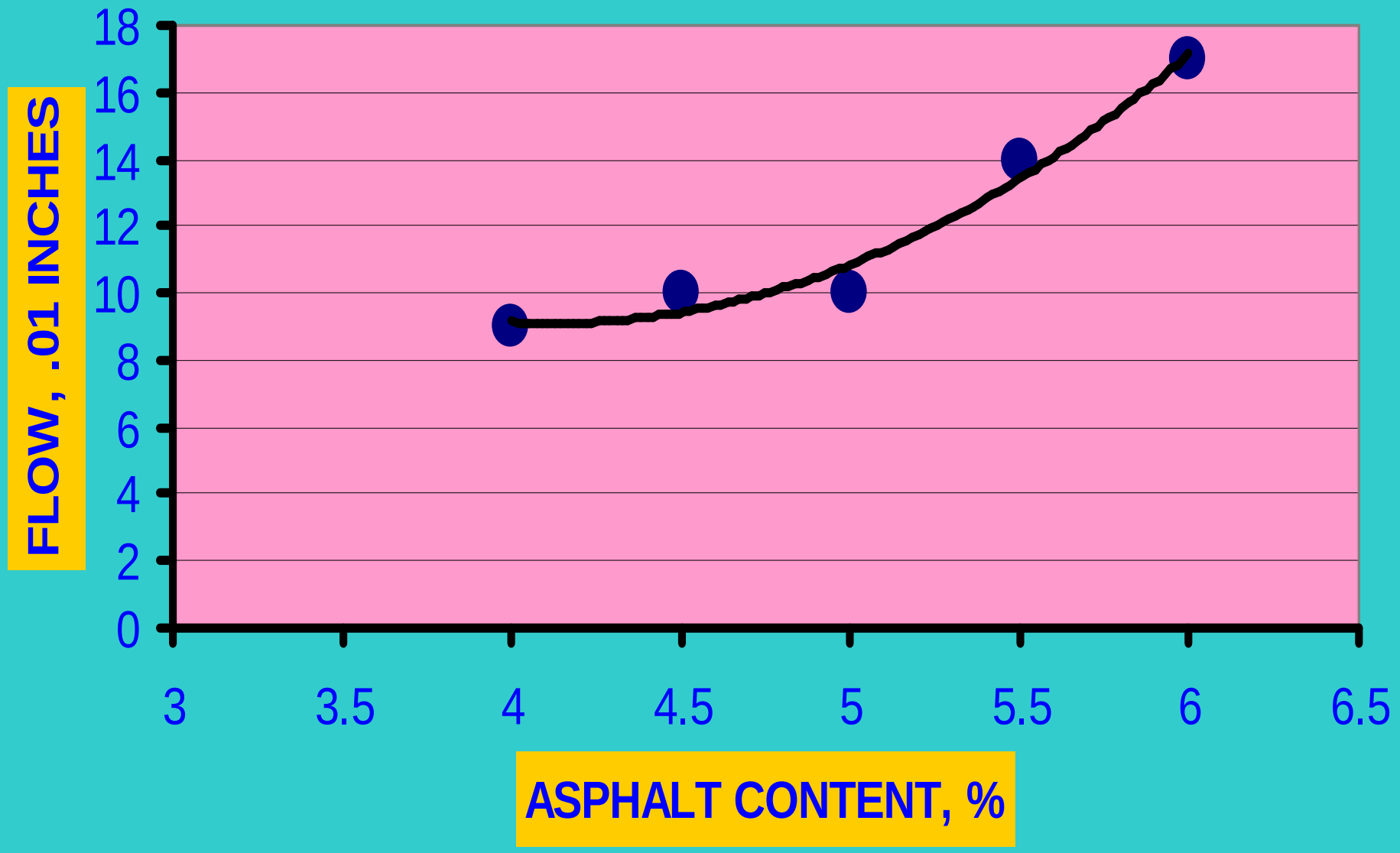
Calculate the Tensile Strength Ratio (TSR)

$$TSR = \frac{\text{Avg. wet tensile strength}}{\text{Avg. dry tensile strength}}$$

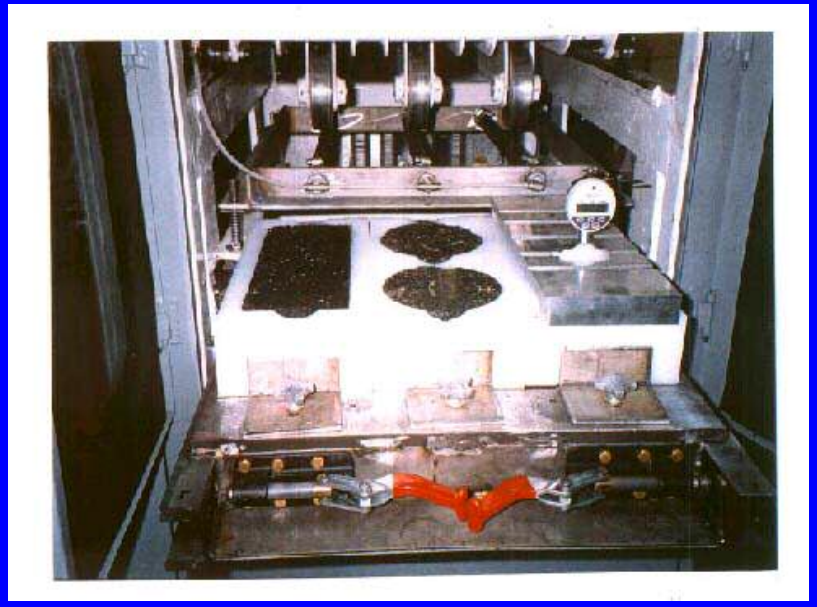
Minimum of 80% needed


STABILITY VS. ASPHALT CONTENT
STABILITY, POUNDS
2000
1950
1900
1850
1800
1750
1700
3
3.5
4
4.5
5
5.5
6
6.5
ASPHALT CONTENT, %

FLOW VS. ASPHALT CONTENT



Asphalt Pavement Analyzer



THE MIX DESIGN IS A STARTING POINT AND WILL LIKELY HAVE TO BE ADJUSTED DURING PRODUCTION

Facts about Mix Design

- Increase in filler results in lower AC
- Smaller Max agg size results in higher optimum AC content
- Manual hammer provides lower optimum AC content than mechanical
- Absorptive aggregate requires higher AC content
- Higher –200 results in higher marshall stability
- Reheating will significantly increase stability

MIX DESIGN CHECKLIST

- AGGREGATE QUALITY
- AGGREGATE GRADATION
- ASPHALT CEMENT GRADE
- ACCEPTABLE PEDESTAL
- SATISFACTORY HAMMER
- COMPACTION EFFORT
- COMPACTION TEMPERATURE
- VOLUMETRIC PROPERTIES
- STABILITY, FLOW, AND MOISTURE SUSCEPTIBILITY

THE END